

CORRELATING INTERNET OF THINGS

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ABSTRACT

As objects become embedded with sensors and gain the ability to communicate, the new information networks promise to create new business models, improve business processes, and reduce costs and risks. One such Model is the internet of things. Sensors and actuators are embedded in physical objects from roadways to pacemakers are linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the Internet. Internet of Things has great potential to support society, to improve energy efficiency and to optimize various kinds of mobility and transport at the same time. However, the Internet of Things raises significant challenges that could stand in the way of reaping its potential benefits. Pitfalls concerning cyber security, theft and hacking of personal and financial data are the ones that are making people agitated.

Electronic devices used at home, workplaces, in a neighbourhood or in a large urban landscape are connected and provide data which is accumulated and analyzed for the benefit of its users. The ability of a simple cell phone connecting to other devices, sensors in public, to regulate traffic and other civic institutions, shows how IoT has merged with data and analytics of data plays a key role and will continue to do so in the future.

Key words: Internet of Things (IoT), Connected, Mobility, Cyber Security, Accumulated, Civic Institutions, Merged

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1. INTRODUCTION

Kevin Ashton, co-founder and executive director of the Auto-ID Centre, is credited with coining the term the Internet of Things “empowering computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory.”

SAP's Research's Stephan Haller defined the Internet of Things as "a world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes."

As broadband internet is more widely available, the cost of connecting is decreasing, more devices are being created with Wi-Fi capabilities and sensors built into them. The cost of technology is going down and smartphone usage is increasing at a fast rate. These factors have created a perfect storm for the "Internet of things" Technology companies have been trying to develop new ways to link the Internet with physical objects.

The advancement of IoT has led to a rise in cloud computing which leverages remote, networked computing resources to process, manage, and store data, advancement in data analytics with new algorithms and rapid increases in computing power, data storage, and cloud services which provide new opportunities for extracting information and knowledge.

A number of companies and research organizations have offered a wide range of projections about the potential impact of IoT on the Internet and the economy during the next five to ten years. Cisco projects that by 2020; there could be 50 billion devices that can connect to the internet. Morgan Stanley, however, projects 75 billion networked devices by 2020.

2. APPLICATIONS

The underlying concept behind Internet of Things (IoT) is far from new. Companies have been using sensors and networks to provide a steady stream of information about where devices are, how they're being used, their condition, and the state of their environment for more than 20 years. One of the earliest applications of such technology has been in the area of energy optimization: sensors deployed across the electricity grid can help utilities remotely monitor energy usage and adjust generation and distribution flows.

The growth in mobile devices and the broad availability of wireless connectivity is now driving IoT to the forefront. Other factors include the emergence of the cloud as a way to store and process large volumes of data cost-effectively, and the rapid deployment of analytics technologies that enable enterprises to manage and extract useful information from large volumes of data, quickly and cost-effectively.

Some of the simple ways in which Internet of Things can create value are:

2.1. Smart Home

Smart Home clearly stands out, ranking as highest Internet of Things application on all measured channels. More than 60,000 people currently search for the term "Smart Home" each month. This is not a surprise. The IoT Analytics company database for Smart Home includes 256 companies and startups. More companies are active in smart home than any other application in the field of IoT. The total amount of funding for Smart Home startups currently exceeds \$2.5bn. This list includes prominent startup names such as Nest or AlertMe as well as a number of multinational corporations like Philips, Haier, or Belkin.

There are challenges companies faces that operate in this space:

- For manufacturers of consumer electronics and hardware, there is a difficulty in creating distinctive features that could increase margins and a lack of brand loyalty in an immature market.
- For Telecom and cable providers a connected home competes with existing high margin products.
- For retail outlets, the challenge of building sales force capability and complexity of value proposition that needs to be communicated to customers.

- At home, the emphasis is on ease of use and to help people lead more comfortable lives. Smart homes filled with connected products are loaded with possibilities to make our lives easier, more convenient, and more comfortable. An example of this is Alexa, the voice assistant on the Amazon Echo. One can ask Alexa to either read that days' news or if while cooking can read you a specific recipe. This device and the like are simple but powerful as they are connected to the world wide web.
- BI Intelligence, the research arm of Business Insider expects the number of smart home devices shipped will grow from 83 million in 2015 to 193 million in 2020. This includes all smart appliances (washers, dryers, refrigerators, etc.), smart home safety and security systems (sensors, monitors, cameras, and alarm systems).
- The most obvious benefit to smart homes is convenience, as more connected devices can handle more operations (lighting, temperature, etc.) and frees up the resident to perform other tasks. Beyond this, smart home devices can help reduce costs and conserve energy.

The following are some examples of IoT devices:

- As stated above the most recent is the Amazon Echo. The device functions as a central hub for your other smart home gadgets. It has a voice activated assistant Alexa for other tasks.
- Nest, a home device manufacturer created a learning thermostat that can automatically adjust temperature based on ones location and uses a farfield sensor to determine the time and temperature from a distance.
- The August smart lock provides enhanced security for the home. When it comes to everyday personal use, wearables such as Fitbits and Apple watches are the most common and popular.
- An office space or office building is also impacted by smart devices. For example, Cisco controls the core functions of its 300 buildings worldwide, including climate, electricity use and security, from four locations.

2.2. Wearables

Wearables remains a hot topic too. As consumers await the release of Apple's new smart watch in April 2015, there are plenty of other wearable innovations to be excited about: like the Sony Smart B Trainer, the Myo gesture control, or Looksee bracelet. Of all the IoT startups, wearables maker Jawbone is probably the one with the biggest funding to date. It stands at more than half a billion dollars!

2.3. Smart City

- Smart city spans a wide variety of use cases, from traffic management to water distribution, to waste management, urban security and environmental monitoring. Its popularity is fueled by the fact that many Smart City solutions promise to alleviate real pains of people living in cities these days. IoT solutions in the area of Smart City solve traffic congestion problems, reduce noise and pollution and help make cities safer. In the city of Santander in Spain, the IoT is helping motorists. The local officials and government have embedded around four hundred sensors in the city center. These register which parking spaces are free or occupied and transmit this information to the cloud via wireless network. It can then direct motorists to the next available parking space.
- In Amsterdam, data was used in waste collection. The city equipped more than 2000 waste bins with sensors. These monitor the fill level and report to the central system. Hence, the waste disposal companies know exactly when a bin needs to be emptied. Instead of regular intervals, they now only collect the waste on demand, cutting down on time spent emptying half-full bins.
- In the Czech Republic, the Rodos Transport Systems Development Center has developed a complex mobility model. This helps in advising police, fire departments and rescue services for planning and holding major events.

2.4. Smart Grids

Smart grids are a special one. A future smart grid promises to use information about the behaviors of electricity suppliers and consumers in an automated fashion to improve the efficiency, reliability, and economics of electricity. 41,000 monthly Google searches highlight the concept's popularity. However, the lack of tweets (Just 100 per month) shows that people don't have much to say about it.

2.5. Industrial Internet

The industrial internet is also one of the special Internet of Things applications. While many market researches such as Gartner or Cisco see the industrial internet as the IoT concept with the highest overall potential, its popularity currently doesn't reach the masses like smart home or wearables do. The industrial internet however has a lot going for it. The industrial internet gets the biggest push of people on Twitter (~1,700 tweets per month) compared to other non-consumer-oriented IoT concepts.

2.6. Connected Car

The connected car is coming up slowly. Owing to the fact that the development cycles in the automotive industry typically take 2-4 years, we haven't seen much buzz around the connected car yet. But it seems we are getting there. Most large auto makers as well as some brave startups are working on connected car solutions. And if the BMWs and Fords of this world don't present the next generation internet connected car soon, other well-known giants will: Google, Microsoft, and Apple have all announced connected car platforms.

2.7. Connected Health (Digital health/Telehealth/Telemedicine)

Connected health remains the sleeping giant of the Internet of Things applications. The concept of a connected health care system and smart medical devices bears enormous potential (see our analysis of market segments), not just for companies also for the well-being of people in general. Yet, Connected Health has not reached the masses yet. Prominent use cases and large-scale startup successes are still to be seen. Might 2015 bring the breakthrough?

2.8. Smart Retail

Proximity-based advertising as a subset of smart retail is starting to take off. But the popularity ranking shows that it is still a niche segment. One LinkedIn post per month is nothing compared to 430 for smart home.

2.9. Smart Supply Chain

Supply chains have been getting smarter for some years already. Solutions for tracking goods while they are on the road, or getting suppliers to exchange inventory information have been on the market for years. So while it is perfectly logic that the topic will get a new push with the Internet of Things, it seems that so far its popularity remains limited.

2.10. Smart Farming

Smart farming is an often overlooked business-case for the internet of Things because it does not really fit into the well-known categories such as health, mobility, or industrial. However, due to the remoteness of farming operations and the large number of livestock that could be monitored the Internet of Things could revolutionize the way farmers work. But this idea has not yet reached large-scale attention. Nevertheless, one of the Internet of Things applications

that should not be underestimated. Smart farming will become the important application field in the predominantly agricultural-product exporting countries.

3. OPPORTUNITIES OF INTERNET OF THINGS

There is a lot of potential to be tapped into with regards to the Internet of things:

3.1. B2B Value

Much of the coverage on internet of things is focused on consumer application – wearables and smart homes with automated products. However there is an opportunity to highlight and exploit business-to-business application which account for almost 70% of the value the will be generated from B2B IoT services over the next ten years.

3.2. Operations

Investing in IoT hardware such as sensors built in equipment and products is the first step. Creating new business value comes from optimizing operations. In factories, sensors will provide a flow of data to optimize workflows and make processes more efficient.

3.3. New Business Models

IoT makes certain business models possible. For example, the ability to track when and how physical assets are actually used allows providers to price and charge for use.

The largest, most sophisticated corporations struggle to make the most of IT. Investing in IoT is both strategic and operational for a company. It gives the ability to capture, analyze, and act on the data that can be collected. This requires not only sophisticated technology, but also an organization that can share data and management that is ready to make data-driven decisions. A company will need to learn how to interpret real-time data and will need to share their data.

3.4. Challenges Faced

With all the benefits of IoT, there are also considerable risk involved as the increase in connected devices gives hackers and cyber criminals more entry points. Aside from the security issues, there is the need for privacy which an average consumer is concerned about.

There are some challenges with regards to the Internet of things:

3.5. Aligning Organization

The adoption of IoT will force a company to modify traditional organizational roles as information technology becomes widely embedded across assets, inventories, and operations. As a result, companies will have to align their IT and operational leadership.

3.6. Security Imperative

Implementing the Internet of Things brings the issue of cyber security to the forefront. IoT poses not only the normal risks associated with the increased use of data but also the vastly greater risks of systemic breaches.

One of the biggest challenges for companies that hope to capitalize on the Internet of things is protecting company and customer data. A range of IoT-based applications depend on access to consumer data, including data collected passively from customers' behavior. One example of this is in the retail industry with a fully automated checkout. Customers can walk out the door of a store without having to wait on line or even swipe a card. Owing to this,

Mckinsey estimates that such technology could save \$380 billion per year for retailers around the world in 2025.

Other applications depend on consumers being tracked by following their smartphones to offer discounts based on what aisle the shopper is in, for example. This involves building trust with the consumer and the consumer in turn having significant brand loyalty.

Along with potential security design deficiencies, the sheer increase in the number and nature of IoT devices could increase the opportunities of attack. Combined with the highly interconnected nature of IoT devices, every poorly secured device that is connected online potentially affects the security of the Internet globally, not just locally. Everyday lives depend on using devices or systems that are Internet-enabled and likely to increase in a hyper connected world. This increasing level of dependence on IoT devices and the Internet services they interact with also increases the pathways for wrongdoers to gain access to devices.

IoT has given businesses access to large amounts of data that can be used in many ways. Two examples of this are:

3.7. Inventory Management

In terms of the retail and manufacturing industries, inventory management is an important way of implementing data. It can save businesses on costs in the logistics of ordering and tracking shipments. As businesses switch to fully digital inventory management, this allows the purchasing department to be notified when stock is running low so that shelves are never empty of popular items.

3.8. Marketing Models

Companies now use data more in their decision making process. Consumers expect to have their preferences targeted and begin to appreciate services which are presented to them based on what they do and don't like. As companies are able to access more data over a period of time through their IoT devices, marketing will move into the information age.

4. ECONOMIC IMPLICATIONS OF IOT

According to Mckinsey, the Internet of things offers potential economic impact of \$4-\$11 trillion a year in 2025. In order for this type of growth to take place, one needs to overcome the technical, organizational, and regulatory hurdles.

- Currently most IoT data is not used. The information is mainly used to detect and control anomalies rather than for predicting demand and outcomes or for optimization which provides greater value for companies.
- B2B applications will garner more value than consumer uses. However, consumer applications such as fitness monitors and self-driving cars have the potential to create significant value as well.
- IoT will have a larger impact on advanced economies. Though, the potential to grow and expand will take place in developing economies and will have a higher overall value impact there.
- IoT users – businesses and consumers, will capture 90% of the value that IoT applications generate. An example in the healthcare space is in 2025, remote monitoring could create as much as \$1.1 trillion a year in value by improving the health of chronic-disease patients.
- Digitization blurs the lines between technology companies and other types of businesses; makers of industrial machinery, for example, are creating new business models by using IoT links and data to offer their products as a service.

5. IOT AND BIG DATA

The value of Big Data and IoT combined gives the power and reach of information. Big data is enabling organizations to collect and analyze data in new ways, helping to transform businesses, industry, government services and people's lives. Added to the capabilities of big data is the new power in the IoT. In order for the full potential of big data and the IoT to be realized, both technologies should be used together.

The IoT provides a tool through which the most interesting and relevant data can be collected. However, just collecting data is not enough. Big data analytics solutions offer insights into how this data can be interpreted, enabling makers in business and government alike. Just like Big Data, IoT adds to the challenge for businesses of managing and making the most of such large amounts of information. It's important for a business to have the appropriate technology in place, it must also have the ability to share data and make data driven decisions. Big data combined with IoT offer the following channels through which businesses can benefit – Customer intelligence, supply chain management, quality management, risk management, performance management, and detection of fraud.

A company that reaps benefits from the integration of big data and IoT, businesses may be able to increase their salary budgets as more money can be spent on wages in light of improvements in both productivity and profitability. Big data and the IoT can also result in increased demand for employees in data-specific roles, for example software programmers and data analysts. This demand can be expected to continue to grow as businesses adopt more data-driven technologies and the IoT becomes increasingly prevalent across different industries.

6. THE ROAD AHEAD

A 2015 report made the following recommendations for the future of IoT and data:

- Technology providers should share best security practices and participate in the development of technology test-beds to demonstrate how solutions from different organizations can work together. Adopters of the Industrial Internet should develop multiple scenarios about alternative futures and map out the company's possible responses and identify processes and organizational structure required to achieve long-term success through data analytics and connected devices.
- Companies need to reorganize their overall business strategy to take full advantage of the latest developments in IoT and data management and partner with other platforms or develop their own. Operational safety and security practices vary greatly across industry domains. There should be common security framework for the Industrial Internet to understand and document existing best practices across industries. This will help identify gaps and requirements for potential innovation, standards or new cyber security products. This also ensures that a unified industry voice when communicating with governments or agencies involving security.
- Policy makers should re-examine and update their data protection and liability policies so that data flow is smoother. In emerging markets, governments need to increase investment in digital infrastructure (e.g. embedded sensors, broadband connectivity) to take advantage of the potential and accelerate regional economic development. Companies worldwide need clear legal guidelines over data ownership, transfer and usage. Governments need to work with each other and industries to simplify data and liability laws.
- Some industries, such as utilities and healthcare, are heavily regulated in many parts of the world. For these industries to benefit from the Industrial Internet, policy-makers will need to revisit and possibly relax existing regulations to provide more flexibility and incentives for companies to invest and innovate.

- The success of IoT and data depends heavily on the presence of robust infrastructures, such as good broadband connectivity and sensors. Emerging markets have a unique opportunity to overtake developed countries in terms of IoT. This can be done through targeted investment.
- Industries, governments and academia need to collaborate on long-term R&D to solve fundamental technology challenges related to security and risk management as well as implement new training programmes, and provide policy incentives to employers and workers to encourage prospective employers to learn new skills specific to the IT sector for high-demand job categories..

7. CONCLUSION

The Internet of Things is a key component of understanding customer behaviour and can unlock potential revenue streams. Smart connections—sensors and beacons, for example will become vital for enterprises, especially when it is time to convert that data into actionable information. IoT has the potential to transform the way companies make products, track goods and assets in the supply chain, provide security for employees and facilities, and provide services to customers. It's enabling transformation in both the private and public sectors.

As more products become smart and connected, software is emerging as the connective tissue. The merging of the physical and digital worlds begins with sensors and sensory data. This is becoming the currency of the Industrial Internet economy, and the foundation for new software-enabled services.

There are ongoing improvements in sensor technologies – including miniaturization, performance, and cost and energy consumption which are making intelligent products more accessible. The workforce impact of digital technologies will be gradual and profound, as the Industrial Internet transforms industries and business practices. System-wide changes take time and planning, business and government leaders and planners will need to act now in preparing for the digital talent market. The Internet of Things involves a complex and evolving set of technological, social, and policy considerations across a diverse set of stakeholders.

Public enthusiasm for the Internet of Things has been muted to date, but enterprises can take advantage of the gap and use it to enhance their own digital capabilities. Provided that enterprises understand the ever-changing environment that the IoT generates, then it could be a perfect fit.

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